AMERICAN

# RAILROAD JOURNAL,

AND

# MECHANICS' MAGAZINE.

No. 2. Vol. III. New Series. | JULY 15, 1839. | Whole No. 338. Vol. IX.

## AN ESSAY ON THE LAWS OF TRADE IN REFERENCE TO THE WORKS OF INTERNAL IMPROVEMENT IN THE UNITED STATES. BY CHARLES ELLET, JR. CIVIL ENGINEER. CHIEF ENGINEER OF THE JAMES RIVER AND KANAHWA IMPROVEMENT. RICHMOND, 1839.

Nothing can be more welcome to the friends of Internal Improvement, than the establishment and elucidation of the principles which govern the trade of public works. While other subjects connected with the duties of Civil Engineering have been handled by those who could bring to their aid the light of exact and natural science, this most important topic, admitting the most exact investigation, has either been neglected, or else declaimed upon as a branch of the too often imaginative science of political economy.

The above named work of Mr. Ellet has complied most faithfully with the requisites for such an undertaking. His investigations, thus sustained by strict mathematical reasoning, are within the comprehension of every one who has mastered the elements of algebra, and thus possesses all the strictness and beauty of development belonging to such a mode of treating the subject, while the simplicity of the language is rather increased than diminished by the preference of the mathematical form of expression. A cursory examination of the work, has led us to entertain very high opinions of its value, not only as tending to settle some of the most important principles of Internal Improvement, but as introducing a most excellent method of conducting such investigations. We have always desired to inculcate more exactness than has hitherto obtained in the treatment of such subjects, for it is sometimes held up as a reproach to the profession in this country, and most unjustly too, that we are particularly inerrent in our notions on topics admitting of great exactness. We therefore welcome with pleasure, the publication of a work showing that neither our notions nor our modes of expressing them, are of this inerrent stamp—and proving that if such an essay is written, as the author says, amid the thousand cares of

the charge of a work progressing under a force of 4000 men, and of a survey of a line of 300 miles in length, it is not only an excuse for the scarceness of such works from our civil engineers, but a cause of admiraration for the neatness with which the present volume has been brought out.

We cannot but bear evidence to the extraordinary beauty of the typographical execution of this useful work, rendering it a pleasure to peruse it.

We should have previously noticed this treatise, but have accidentally been deprived of a sight of it until quite lately.

---

For the American Railroad Journal and Mechanics' Magazine.

ON THE TRUE EXPRESSION OF THE POWER, VELOCITY, ETC. OF LOCOMOTIVE ENGINES: BY W. M'CLELLAND CUSHMAN, CIVIL ENGINEER.

*Gentlemen:*—On perusal of Chev. De Pambour's work upon locomotive engines, I noticed a disagreement between velocities computed from his general formula and those determined by experiment, in an instance or two, in which the diffierence was very decided. As the *formula alone* could make his experimental results *available in practice*, I was induced to make an extended comparison between the formula and actual trial, when I became satisfied the difference was not incidental, but effected *all the results*, in a greater or less degree. This surprised me not a little, as every page of the work evinced capabilities in its author adequate to the profoundest researches—who, moreover, had neither excluded, or left uninvestigated, any of the *usual elements* of the question. Hence the conclusion was forced upon me, that some essential element or elements had hitherto been omitted by engineers—and for my own satisfaction I set about an investigation, and was successful in discovering them, as well as the laws which they obeyed; when, of course, there was no difficulty in involving them in a new formula, which I did for my own professional use and guidance. This has quietly reposed among professional memoranda without any attempt, perhaps I may add, intention, on my part, of publishing it, partly impelled for want of leisure, [having engagements which claimed my attention at the south] and partly wishing to avoid a critique [possibly the worse excuse] upon a work which every engineer will concede to be a boon to the profession of transcendent usefulness, though its distinguished author *failed to complete the superstructure* for which he had laid so exquisitely proper a foundation, in his beautiful series of experiments.

At present I have leisure; and am the more willingly induced to break through the restraints I had imposed upon myself, inasmuch as the formula in question has been attacked by several engineers, and been defended with much ability by his friends. It is sufficient, however, that *neither of the points where my researches lay the default, have been investigated;* and *that the actual powers of the engine have, in consequence, never yet been expressed.* So much for criticism—now to the proof. The formula of de Pambour is, [see pp. 189, Lond. ed.] $v = \frac{m\,c \cdot p}{55\left\{\frac{2}{3}\varphi + \frac{5d^2lx}{D}\right\}}$

expressing all quantities in inches except the evaporating capacity $c$, which is feet, and putting $\varphi$ = the friction and gravity of the engine and train in lbs. avoirdupois—for the convenience of using my notes, of which the sequel is nearly a literal duplicate; and the following is an abstract of De Pambour's *experiments* upon the Liverpool and Manchester railroad, with the *corresponding results of this formula*, in a tabular form, [I subjoin dimensions of the engines, the pressure, &c., that the calculations may be made by those who feel interest enough in the subject to repeat them,] viz:

| Number. | Designation and Dimensions. | | | | | | Gravity in lbs. | Speed miles per hour. | | Error per cent. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Name of the Engine. | Load in Tons. | $l$. in | D. inches. | $d$. | $p$. in lbs. | | By experiment. | by the formula. | | | |
| 1 | Atlas. | 127.6 | 16 | 60 | 12 | 68. | —2.05 | 17.1 | 18.9 | .10 | per cent. | |
| 2 | | 195.5 | | | | 70. | 1.72 | 8. | 10.5 | .31 | | |
| 3 | | — | | | | 68.½ | 0. | 9.2 | 12. | .30 | | |
| 4 | | 66.7 | | | | 48.½ | —2.05 | 21.8 | 25.7 | .18 | | |
| 5 | | — | | | | — | 0. | 20. | 22.3 | .11 | | |
| 6 | | 40.1 | | | | 40. | —1.72 | 23. | 29.0 | .26 | | |
| 7 | | — | | | | 66. | 25.2 | 7.5 | 11.8 | .57 | .26 | mean |
| 8 | Fury. | 38. | 16 | 60 | 11 | 67. | 0. | 25. | 33.7 | .35 | | |
| 9 | | — | | | | 69. | — .52 | 25.7 | 34.6 | .30 | | |
| 10 | | — | | | | 68. | —1.72 | 26.9 | 37. | .38 | | |
| 11 | | — | | | | 67. | 2.64 | 24.6 | 29.2 | .19 | | |
| 12 | | — | | | | 69. | 25.2 | 13.3 | 14.0 | .05 | | |
| 13 | | — | | | | 67. | 2.05 | 24.8 | 30.3 | .10 | | |
| 14 | | 56.2 | | | | 70.½ | 1.72 | 21.8 | 25.8 | .18 | .22 | mean |
| 15 | Vesta. | 94. | 16 | 60 | 11⅛ | 68. | — .52 | 18.4 | 21. | .14 | | |
| 16 | | 48.7 | | | | 67. | 0. | 24.0 | 33.7 | .40 | .27 | mean |

These tabular statements and results prove, very conclusively, that the formula *does not agree with experience*, departing, in every instance cited, more or less, by an amount averaging for each engine from 22 to 27 per cent., and ranging frequently much higher, sometimes even to 57 per cent.! *Note a.* Certes, then, nothing gratuitous has been predicated, enough being here exhibited to establish clearly my position, that the *formula cannot be depended upon.*

But can a good solution be effected? I answer yes—and rest the assertion upon the subsequent discussion of *certain neglected considerations* which are indispensable.

Now one circumstance exhibited in this table is very striking: the *calculated velocities all range above their real values* determined by the experiments, which implies an omission of some important resistances—and proves that it is *not sufficient to allow for the influence of friction and gravity.* Before a formula will express true results, this resistence, at least, must be brought into it. But there is besides an important *principle* which has been entirely overlooked in its construction; and, singularly enough, this is to be found in the one or two chief points which distinguish the modern from the old time locomotive, viz, using up the steam after it has operated upon the pistons, to advance the combustion—thereby gener-

ating, in a given time, a greater quantity of steam than is possible without the arrangement, and, of course, increasing it with the speed.

Yet, though [as will appear] so very large a share of power is derived from this principle, and the fact is so obvious as constantly to present itself to observation, its influence has been ever and perseveringly overlooked in calculations—no *attempt*, even, having ever been made *to discover the relative degree of evaporation as the speed is advanced or retarded.* Here then, is another point *affecting* the *intrinsic power of the machine*, to be added to the omitted resistance, and these, together, will account for the remarkable deviation of the deductions of the formula from the actual trial as when allowed for, the results of experience may be anticipated, *a priori* by calculation, with precision. As to this latter principle, an experiment upon the Atlas gave these results—with an average velocity of 8.99 miles per hour, the evaporation was 40.25 cubic feet per hour; and the mean of two other experiments upon this engine [made at nearly equal velocities] is 15.26 miles and 47.4 cubic feet of water evaporation. The exponent of the power of $v$ is then very nearly 1-3—that is, the quantity of water raised into steam in a given time, is *as the cube root of the velocity of the engine.* Those of the other experiments that can be confided in, confirm this result very precisely: or if varied according to this ratio, the deduced results will agree with the experimental values: this, then, must be regarded as a *general law inseperable from the locomotive engine of modern construction.*

Suppose, now, the evaporating power of an engine has been found, at—say 19 miles per hour: at 5 miles it will generate but 64 per cent. of that quantity, while at 40 miles it will raise 128 per cent. of the same quantity into steam---which is *double that at 5 miles*---for $\left|\frac{5}{19}\right|^{\frac{1}{3}} = .64$ and $\left|\frac{40}{19}\right|^{\frac{1}{3}} = 1.28$, and *the motive power of the steam, is precisely in the same proportion.* An error of 100 per cent. within the practicable range of the velocities, being thus shown to be *inevitable* when this law is neglected, an *invariable length of stroke*, or *diameter of operative wheels* might with as much propriety *be assumed, as that the evaporating power is constant.*

Now the mean generation at 19 miles, has been accurately determined [designated by $c$ in the formula] and at any varying speed the corresponding generation will be $c \cdot \left|\frac{v}{19}\right|^{\frac{1}{3}}$ cubic feet per hour. When then, this is allowed for, the equation becomes $v = \left|\frac{3\,m\,c\,p}{440 \cdot \left\{\frac{2}{3}\varphi + \frac{5d^2 lx}{D}\right\}}\right|^{\frac{3}{2}}$.

From the manner in which $c$ varies with the velocity it is evident that when the speed is greater than 19 miles the generation will *exceed*, and when less than 19 miles it will *fall below*, its mean value at that speed. Hence the results computed from this expression will come out sometimes higher and sometimes lower than by De Pambour's—the two agreeing only

at one point, 19 miles, but his formula gives in all the instances, results much higher than can be attained in practice: at high velocities, therefore, the last expression will evidently *increase the deviation*, while at lower speed, it will approach gradually nearer the real state of things than the Chevalier's. As yet, then, only a partial solution is obtained, after allowing fully for the effects of this principle.

Now, another circumstance peculiar to this expression is this: its results *diverge* gradually more and more as the speed is raised—some *variable* resistance to the motion, therefore, *yet remains to be estimated*:—this is the resistance which was previously noticed. But as every *inherent* resistance of the engine and train in convoy has been allowed in its full and proper extent, that only which answers to the indications of the formula, is the *external resistance of the atmosphere*—which suits those conditions precisely, as its effects *vary with the velocity*.

It would be easy to allow for this, *a priori*, if the exact extent of plane superficies presented by the various parts of the engine were given. But how estimate the force of the wind upon a tree with its myriad limbs? and the case seems a good parallel to an attempt to define the flat surface equivalent to those of the boiler, frame, rods, smoke stack, &c., of an engine. Perhaps this is the reason why engineers have always neglected a resistance which is known to be considerable at even moderate speeds: how else do a few yards of canvass presented to the gale, plough, for the stately ship, its way upon the deep—a feat that engines of some 500 horse power are scarce able to accomplish? Now, the motion of a locomotive, in reference to the atmosphere, *in its quiescent state*, answers to the speed of the wind in the former—*opposing* the passage of a locomotive in proportion to its speed and surface presented, precisely as the wind *forces* onward the ship in proportion to its velocity and the surface of her sails; and I do not see the necessity of attempting to estimate *directly* the amount of surface, for if $a$ = force in *lbs.* upon a unit of the surface $s$, when the speed is $v'$, the total resistance to motion in *lbs.* will be $a\,s\frac{v^2}{v'^2}$ with the variable velocity with which the engine works, after refering this to the piston it may evidently be introduced into the formula among the other resistances. Now $a$ and $v'$ are known *a priori*, and the entire co-efficient $\frac{a\,s}{v'^2}$ is constant. I therefore take an experiment in which all the other quantities are given, and resolve the equation in reference to this constant co-efficient, *note b*, the result is placed instead of it in the general equation. In this way the atmospheric influence is truly provided for without any knowledge of the actual surface presented—this done, my final equation is,

$$\sqrt[3]{v^2}\left\{v^2+2{\cdot}5\left|\frac{2}{3}\varphi+\frac{5d^2lx}{D}\right.\right\}=\frac{3\,m\,c\,p}{176}$$

an expression based entirely upon experimental results, and which, there-

fore, will now agree with experience. In further illustration, in a practical way, of the correctness of its principles and its analysis, I beg leave to present again the list of experiments detailed in the opening of this paper, in comparison with results calculated by this formula: viz.

| Number. | Velocities. By experiment. | Velocities. By calculation. | Number. | Velocities. By experiment. | Velocities. By Calculation. | Number. | Velocities. By experiment. | Velocities. By calculation. | Error per ct. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 17.1 | 17.1 | 8 | 25.0 | 25.9 | 15 | 18.5 | 18.9 | |
| 2 | 8.0 | 7.5 | 9 | 25.7 | 26.4 | 16 | 24.0 | 23.3 | |
| 3 | 9.2 | 9.5 | 10 | 26.9 | 27.6 | means. | 21.25 | 21.10 | .01 |
| 4 | 21.8 | 21.9 | 11 | 24.6 | 24.0 | means. | 23.10 | 23.03 | .01 |
| 5 | 20.0 | 19.7 | 12 | 13.3 | 11.5 | means. | 15.23 | 15.36 | .01 |
| 6 | 23.0 | 23.5 | 13 | 24.8 | 24.5 | | | | |
| 7 | 7.5 | 8.3 | 14 | 21.8 | 21.3 | | | | |
| means. | 15.23 | 15.36 | means. | 23.10 | 23.03 | | | | |

The *average* deviation for *each engine* by the formula of the Chevalier [see first table,] ranged from 22 to 27 per cent. above those of experience: in the last table, the departure from the experimental averages of each engine, is *never as much as one per cent.*—a deviation which, besides being "too trivial for accompt," will be viewed by those, who, like the engineer, have occasion to apply grand and comprehensive principles to practical purposes, as proof that the coincidence is in no-wise accidental: and the more extraordinary, as he seldom has to do with powers so subtle and variable, or resistances equally complex and evasive.

The equation of the maximum load is so easily derived from my general formula by the scientific engineer, that it need not be discussed; and I will only further remark, that the engines of the Liverpool and Manchester railroad, which furnished these experimental results, all operate upon the principle of *exhaustion;* there is no reason, however, why these principles are inapplicable to engines operating with a *direct blast*, which is but the converse of the other. For instance, the engines of the Baltimore and Ohio railroad have a blast, and differ besides in the disposition of the boilers, the kind of fuel, &c. Mr. Knight, the chief engineer of the road, found that the Arabian, drew upon a level, a gross load of 112 tons 18¼ cwts., at the speed of 11.79 miles per hour—by the formula it comes out 11.7+ differing *less than one per cent from the actual trial.* This, besides, is an interesting fact, as it proves conclusively, that we have engines in this country, purely American in plan and construction, at least equal to the best European. It is to be regretted, that so few of the trials meant ostensibly to show the powers of our engines give sufficient details to infer their real performance, nearly every attempt omitting some essential fact. This, by the way, is so important, that I will take leave here to suggest, that unless *all the quantities involved in the formula*, are distinctly and precisely stated, it is impossible to form any true idea of what an engine has really done.

Albany, August 13th.

*Note a.* The list of De Pambour's experiments furnishes much greater devia-

tions *than even the highest of this table.* It would, however, be unfair to quote results which were evidently affected by some casual perverting circumstances: such of the results of each sett of trials as were *inconsistent among themselves*, have accordingly been rejected. For instance, 16th July the Atlas made 15. miles per hour upon a level grade, and with same load upon an *ascending grade* it made 22.6 miles per hour, which is manifestly absurd. Here, probably, the engine had not got up steam upon the *starting level grade.* So with the Fury, under similar circumstances, 24th July. In some instances, the wind produced evident anomalies—witness, Vesta, 1st August: in others, the engine was out of order; and so, again, there are very remarkable deviations which I refer to insufficient adhesion. These are all *accidents*, having nothing to do with the real performance of engines, or their daily routine of duty.

*Note b.* This co-efficient comes out .4 very nearly: at 30 miles per hour, therefore, 4 $v^2$=360 *lbs.* is the force with which the atmosphere opposes the motion of the engine, which is the trackage of 45 tons upon a level, or 10 cars fully laden! How absurd, then, are those deductions where the atmospheric influence is rejected?

---

## Railway fares.

(Continued from page 14.)

"The following statements will show how far the Belgian surpasses the English railroads in cheapness of fares. In the former country there are four classes of carriages, the cheapest of which is only 2-7ths, or less than one-third of the English, and only 4-10ths of a penny per mile. In England there are sometimes not more than two classes, the lowest of which bears a very different and a much higher proportion to the superior carriages. The Manchester and Liverpool railway affords a favorable opportunity of comparison, as the distance is about the same as that between Brussels and Antwerp; the former being about 30 miles and the latter 27 1-4 miles. The fares are as follows:—

| *Liverpool and Manchester*, 1837. | s. | d. | *Brussels and Antwerp*, 1838. | s. | d. |
|---|---|---|---|---|---|
| Mails | 6 | 6 | Berlins | 2 | 11 |
| Coaches | 5 | 6 | Diligences | 2 | 6 |
| Wagons | 4 | 0 | Chars-a-banc | 1 | 8 |
| | | | Wagons | 1 | 1-2 |

"On the English line, therefore, the lowest class is nearly two-thirds of the highest, and the rate per mile for the lowest class is equal to the rate of the highest on the Belgian lines, viz:—

| *Liverpool and Manchester.* | | *Average of Belgian Lines.* | |
|---|---|---|---|
| Mails | 2 1-2*d.* per mile. | Berlins | 1 1-2*d.* per mile. |
| Coaches | 2 1-8*d.* " | Diligences | 1 1-4*d.* " |
| Waggons | 1 1-2*d.* " | Chars-a-banc | 3-4*d.* " |
| | | Waggons | 1-2*d.* " |

The writer proceeds to offer a comparison of the present amount of travelling in England and Belgium, observing:—

"The Liverpool and Manchester Railroad offers a very favorable com-

parison for this country, as the intercourse between those two towns is perhaps greater than between any other two places at an equal distance. The number of passengers booked at the Company's offices on that line since its opening has been as follows:—

| | | |
|---|---|---|
| In 1830 | (from the 16th September to the 30th December,) | 71,951 |
| 1831 | (the whole year) | 445,047 |
| 1832 | " | 356,945 |
| 1833 | " | 386,492 |
| 1834 | " | 436,637 |
| 1835 | " | 473,849 |
| 1836 | " | 522,991 |

"The population of the towns on this line, exclusive of the adjacent districts, which teem with inhabitants engaged in commerce and manufactures, was in 1831—Liverpool, 196,694; Manchester, 270,963; Warrington, 19,155; total, 486,812. This number could not have been less in 1836 than 523,000, which is the number of passengers using the railroad in that year. On an average, therefore, each inhabitant may be supposed to take one trip in a year.

"In Belgium the number of passengers booked at Brussels, Mechlin, and Antwerp, inclusive of two intermediate stations, in each year since the opening of these lines has been as follows:—

| | *Brussels.* | *Mechlin.* | *Antwerp.* | *Total.* |
|---|---|---|---|---|
| 1835 [8 last months] | 215,342 | 206,097 | | 421,439 |
| 1836 [Antwerp only 8 months] | 379,588 | 265,048 | 226,671 | 871,307 |
| 1837 | 475,155 | 364,317 | 305,995 | 1,145,467 |
| 1838 [10 months] | 511,326 | 338,351 | 299,146 | 1,148,823 |

"The population of these three towns did not in 1838 amount to one-half of that on the English line, namely, Brussels with its surburbs, 134,302; Mechlin, 22,895; Antwerp, 75,363; total, 232,960; and neither the population nor the commercial activity of the surrounding districts can be compared with those of its competitor, yet the intercourse in 1837 was more than twice as great; and with reference to the difference of the population was five times as great, the average number of trips to each inhabitant having been five per annum. A comparison with the intercourse on both lines previous to the formation of the railroads is equally favourable to the Belgian undertaking. On the Liverpool and Manchester line the average number of passengers which the coaches carried in the year 1825, was estimated at 450 daily, or 164,250 per annum. The number actually conveyed by the railroad in 1836, was 523,000, showing an increase of 218 per cent., or rather more than three times the former number; the fares having been reduced from 10*s.* and 6*s.*, to 5*s* 6*d.* and 4*s.*; the higher rates one-half, and the lower only one-third. On the Belgian line the number of passengers between Brussels and Antwerp, before the opening of the railway, is said to have been 80,000 yearly. The rates of conveyance have been reduced from 4*s.* and 2*s.* 6*d.* to 2*s.* 6*d.* and 1*s.* 01-2*d.*; the higher fares two-fifths, and the lower three-fifths; and in 1837 the number of passengers booked at Brussels and Antwerp, excluding Mechlin, whence a portion of the passengers were proceeding on other lines of railway, was 781,250, showing an increase of 876 per cent., or about nine and a half times the former number. If Mechlin be included, the increase will be fourteen times the former number. An analysis of the classes of travellers will show that this superior activity is in a great measure owing to the cheapness of fares. Of the total

number of passengers during the six months ending 30th of October, 1836, the proportion using each class of carriages was as follows:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Berlins, paying | 2*s.* | 11*d.* | 1.7 | per cent., yielding a revenue of | | 5 | per cent. |
| Diligences . | 2*s.* | 6*d.* | 3.7 | " | " | 9 | " |
| Chars-a-banc | 1*s.* | 8*d.* | 22.2 | " | " | 32 | " |
| Wagons . | 1*s.* | 0½*d.* | 72.4 | " | " | 54 | " |
| | | | 100 | | | 100 | |

The proportion of persons travelling short distances only in wagons is still greater, but the above is sufficient to show how large a portion of the whole revenue of the company is derived from passengers of the lower class paying a very small fare; and it is a just inference that the high rates of fares on the Liverpool and other railroads in England do very materially check travelling; that to the artisan they entirely prohibit travelling for pleasure; that they restrain even the wealthy in the use of this source of recreation; and it can scarcely be doubted that they interfere with journeying on business. Whether an increase of numbers at a low rate would repay the corresponding additional outlay for locomotive power, wear and tear, &c. is another question, upon which the evidence afforded by the Belgian Railway is also important. The following result of the operations on all the lines since they were severally opened, tends to show that the experiment has been successful:—

| | | | *Expenses.* | *Receipts.* | *Excess of Receipts.* |
|---|---|---|---|---|---|
| 1835 | 1 section open | 8 months | 6,748*l.* | 10,756*l.* | 4,008*l.* |
| 1836 | 1 " | 4 " | 17,244 | 33,004 | 15,760 |
| | 2 " | 8 " | | | |
| 1837 | 3 " | 6 " | 46,216 | 56,676 | 10,460 |
| | 8 " | 4 " | | | |
| 1838 | 6 " | 3 " | 64,768 | 105,340 | 40,572 |
| | 8 " | 4 " | | | |
| | 10 " | 3 " | | | |

The cost of these ten sections, including the materials, was about 1,360,000*l.*, the interest of which sum, at 5 per cent. per annum, would amount to 68,000*l.*; and for ten months, to compare with the above, it would be 56,667*l.* But it must be borne in mind, that the whole of the ten sections were only in operation during three months, and therefore the profits of 1838 must not be charged with the cost of all the sections. The receipts at Ans, which section was only open seven months, amounted to nearly one-third of those at Brussels during ten months, and the line from Bruges to Ostend was not open three months. The following were the receipts at each principal town:—

| | |
|---|---|
| Brussels | 29,882*l.* |
| Antwerp | 16,553 |
| Ghent | 13,114 |
| Mechlin | 11,640 |
| Ans | 9,571 |
| Louvain | 7,728 |
| Tirlemont | 4,218 |
| Ostend | 1,607 |
| Other towns | 11,027 |

This statement sufficiently indicates the favourable prospects of the undertaking.

## THE CENTRAL AND OTHER RAILROADS.

While many of the schemes of Internal Improvement, throught the Union, are confessedly falling to the ground, or have already perished, it is cheering for Georgia, to turn to her great work, the Central Railroad, and have the satisfaction to know that it has progressed beyond all comparison.

No work of the kind ever was attempted without doubts and misgivings on the part of some exceedingly wise persons—who always know more than their neighbors—especially if they are so extremely disinterested, as not to embark a dollar in the enterprise. Then, of course, their words are cheap and they can speak with freedom. These kind of people, like other folks, have generally *two* eyes—but one of them is an envious one, and with it they can see nothing profitable or patriotic in which they are not themselves immediately concerned. "Croakers" are proverbial, and sensible men treat them as BENJAMIN FRANKLIN did, when old BRADFORD endeavord to dissuade him from commencing the printing business in Philadelphia. The "Croakers" of the Central Railroad project, however, having seen all the difficulties they prognosticated vanish before time, are nowhere to be found—or have abandoned their vocation.

The Central Railroad is now in operation upwards of 80 miles. It is daily shortening the distance between this city and our flourishing sister of the interior—Macon. The day is not far distant when a few hours travel will make us one people. Macon must ever be an *entrepot* for the cotton of the interior of Georgia; but there are other commodities not so bulky as that valuable material, to which we must soon look to the upper regions of Georgia for a supply. It is a fact that more grain has been raised in this State last season, than was ever produced in Georgia before. In some of the midland counties, we understand that fine flour can be had at the rate of $3 00 per cwt. at the mills—superfine at $3 50. This spring the farmers in the Up Country, have gone larger into the cultivation of grain, than they did last—so that we hope to see the day when the Savannah market will be entirely supplied with Georgia flour. Corn and Bacon, these "staffs of life," will also find their way here—and butter and cheese.

Really, we should be ashamed of ourselves, as Georgians, to have slept so long, and paid so heavy a tax for what we could have raised ourselves—but, moreover, for permitting the vast natural advantages of our State to remain without assistance, and without application. But the ice is now fairly broken, and the stream of Internal Improvement has overflowed and carried with it all barriers—never more to be blocked up by the chilly and freezing air of neglect. Let it roll on, until it has fertilized the woodland and the plain! Let the mighty tide never cease to flow, until Georgia takes her station amongst her sisters of the Union—and holds her beauteous head as high as the proudest!

Let us contemplate for a moment the scene that may be when the Central Railroad is completed to Macon—when it reaches, by means of the intersection at Waynesboro', Augusta. Then will Savannah, the seaboard of the State, have at least a fair chance of becoming what she should be, the emporium of the South. The merchants of Macon and Augusta, can visit our city in one day, and return to their homes the next. The trains of cars laden with the produce of Georgia, from the cities we have named, will glide along our road, and be transported to our storehouses or wharves in a few hours. Hundreds who would never leave home, when the journey would be two or three weeks in duration, will lay aside for a day, their cares, and visit the large cities of their native or chosen State, to see and

be seen, and to become acquainted with their fellow-citizens, who reside in other places.

Our cities will be thronged—our people will be employed, and industry and enterprise will obtain a certain reward. Other improvements will be made throughout the country, especially in the neighborhood of the railroad or its branches. The people in those quarters will wake up, and catch the spirit of improvement as it flies along. We will be a prophet for once, and augur that the people of Georgia will bless the day, when the project of the Central Railroad was first started—and posterity will honor and revere its authors.

Our readers will see that a small profit is derived already from the stock, before the work is half completed. A dividend of one dollar per share has been declared by the Company *from the profits* of the railroad.

It is not, however, the above project alone, that will enrich our State. The Georgia Railroad Company, an abstract from the Engineer's report of which we gave the other day, is in a most flourishing condition. It will soon be completed, and will pay its stockholders well, and be a vast benefit to Georgia.

The Monroe railroad, too, is doing well. We believe it has fully come up to the expectations of its projectors; and the connexion of Macon and Forsyth, effected by this road, is all important, to keep up the chain of railroads, from the seaboard to the mountains.

The Great State road from the Tennessee, is also in a proper train. We append the last report of the Board, which it will be seen, is very flattering.

Having thus made a brief sketch of the present and future prospects of Georgia, connected with Internal Improvement, we may ask, will the next legislature be prepared to enter into the spirit of the day? Will it lend the credit of the State to works that have proved beyond all doubt, their practicability—their advantage? Time alone can determine this question—but the weal or woe of Georgia, is, as yet, in the hands of the people. They have the selection. Let them make a good one.

No man is worthy of the station of a representative of the people, who will allow sectional or unworthy feelings, to interfere with his duty as a legislator. Let the citizens of Georgia, see whether they have sent such men to the General Assembly before, and if they have, let them make amends, by scouting their pretensions now. Certain it is, that sectional prejudice has operated to such an extent in former legislatures, as to stay the tide of improvement---nay, to divert it from its course---and keep it so for years. The men who lent themselves to this proceeding, have a great sin to answer for. They have done a deep injury to their State---many of them, no doubt, without being aware of it----but the evil is not the less.

Men of sound common sense----of integrity----of sufficient discrimination to know that fine, flowery speeches, and plausible exteriors, are not the only attributes of patriotism----who possesses a good practical knowledge of the every day affairs of life, together with an education, plain but fair, which can detect the designs of demagogues, and blow to pieces the webs of sophistry----are the men to make legislators.

Give us such men as these, and we will warrant that they are advocates for Internal Improvement---that they go with the age, and are not behind it---that they will spin no long-winded harangues and while away the time of the Assembly, preaching economy---of the great expenditures of the State---of its empty coffers---while all the time they are pocketing their *five* dollars a day, and remain in Milledgeville *five* times as long as it is necessary---for no other purpose, we presume, than to continue the agreea-

ble task of pocketing the aforesaid *five* dollars a day---and exhibiting their talent for speech-making.

We have made these remarks, because we see that many counties of the interior are about to make their nominations of candidates, and we hope they will have some effect. The policy of Georgia, above all others at this day, is to encourage Internal Improvements---sensibly and usefully conducted. Let the people of this State do their duty, and Georgia will assuredly become the highway for the commerce of the Mighty West. Let not party spirit interfere with this vital question; for we hope that both parties will, as in duty bound, choose men pledged to Internal Improvement.—*Georgian.*

---

COMMISSIONER'S OFFICE, WESTERN AND ATLANTIC RAILROAD.

Cassville, April 30th, 1839.

SIR---That object of the fourth section of an Act, passed 23d December, 1837, requiring the President of the Board of Commissioners of the "Western and Atlantic Railroad," to make quarterly returns to the Governor of this State, may be effected, I herewith, in the absence of the President, and by direction of the Board, transmit to your Excellency, a statement of the work done on that road, and of disbursements made on account of the same, for the first quarter of the current year, together with the necessary vouchers.

| | | |
|---|---|---|
| Aggregate of Grading, | 1,184,704 | Cubic yards. |
| " Masonry, | 11,285 | Perches. |
| " Bridge Timber, | 480,588 | Feet. |
| " Framing, | 10,617 | " |
| " Iron, | 6,036 | lbs. |
| " Bolts, | 373 | " |
| " Zinc, | 480 | " |
| " Com. road bridge timber, | 1,052 | feet. |

For which the sums payable monthly, agreeably to contracts, amount to $266,934 00 of which the sum actually paid is, $264,098 15

| | | | |
|---|---|---|---|
| The sums retained for final settlement, on fulfilment of contracts, | 53,173 14 | do. do. | 11,616 72 |
| Total amount chargeable on account of construction, | 320,107 14 | | |
| Paid for right of way, | | | 2,800 50 |
| Paid through Chief Engineer to Engineer Department, and for other objects, | | | 19,952 86 |
| Paid incidental expenses, | | | 628 50 |
| Total amount disbursed, | | | 299,096 75 |
| Balance due on amount payable, | | | 2,835 85 |
| Balance due on amount retained for final estimates, | | | 41,556 42 |
| Aggregate cost on 1st quarters operations, | | | $343.489 00 |

All of which will appear by reference to accompanying documents, marked A, B, C. D. E.

I have the satifaction to add that with the exception of an affray which occurred among some laborers near the 5th section of the first division, and which resulted in the death of two individuals, harmony has prevailed upon the line during this quarter, and that the work is progressing with a rapidity corresponding to the magnitude of our disbursements.

Very respectfully your Excellency's,

THOMAS HAMILTON, *Com. W. & A. R. Road.*

His Excellency, George R. Gilmer.

AUGUSTA CITY COUNCIL.

The following resolutions were passed at the last meeting of the Augusta City Council:—

By Mr. Harper.

*Resolved*, That the City Council of Augusta will unite with that of Savannah in a memorial to the next General Assembly of Georgia, praying for the State's aid, by a loan of its bonds for the sum of $100,000 to each city, to be used, if deemed expedient, in effecting a continuous railroad communication between the two cities; the work to be commenced at Augusta.

By Mr. Harper.

*Resolved*, That the City Council will apply to the General Assembly of Georgia, at their next session, to make an adequate appropriation for deepening, under the superintendence of a competent Engineer, the shallow bars of the Savannah river, so as to admit of Steamboat Navigation in low river, and respectfully request the City Council of Savannah to unite with them in this application.

By Mr. Nelson.

*Resolved*, That the City Council of Augusta defer any further action on the application from the South Carolina Canal and Railroad Company, respecting the location of a depot in this city, until the report from the committee of five, appointed by the citizens, be received.—*Constitutionalist.*

---

EXPERIMENTS ON BLASTING.

Some weeks ago, a large party of gentlemen assembled in Craigleith Quarry, at two o'clock, to witness some experiments on blasting by means of galvanism, which were made at the request of the Directors of the Highland and Agricultural Society of Scotland, by Martin Roberts, Esq.

The apparatus consists of a small trough about a foot in length, and four inches square on the end, and a battery containg ten pairs of plates. Along the battery runs a bar upon which a tin disc slides freely. This disc, when drawn to the end of the bar, touches another disc, and thus completes the connexion between the opposite poles of the battery. To prevent accidents, the sliding disc is kept in the middle of the bar by means of a spring of colied wire; and it is impossible to put the battery in action, although sunk in the trough, without shifting the plate along the bar to the opposite end of the trough. The copper wires which convey the electric fluid to the gunpowder, are kept separate during their whole course by a sheath of cotton thread, which is wrapped closely round them in the same manner as in the strings of a guitar, or as in the wire which stiffens a lady's bonnet. At their termination these wires are bent outwards, and their extremities are connected by means of a fine steel wire half an inch long, so as to form a small triangle like the Greek capital delta. This triangular end is inserted into a small tin cartridge, and ignition of the powder contained in the cartridge, is produced by the deflagration of the steel wire which connects the ends of the two copper wires. So rapid is the progress of the electric fluid, that it is impossible to measure the interval of time which elapses between the action at the trough and the explosion of the cartridge. The cost of this apparatus is only about fifteen shillings, and the price of the materials required for the solution is such, that a shilling will cover the expense of keeping the trough in a working state for months. The copper wire, which, if properly shielded, may last for years, costs about one farthing for each yard.

One great advantage of this new system of blasting is, the great facility which this mode gives for blasting under water. This is one of the most

inconvenient, expensive, and uncertain of all engineering operations. It involves much trouble and expense in laying hoses for the train or fuze, which are destroyed every time, and after all there are, perhaps, three failures out of ten trials. All this is avoided by Mr. Roberts' system, which is as efficient under water as above it, and involves not one farthing of loss under water more than on land.

There is absolutely no vent hole in the mode of tamping pursued by Mr. Roberts, which mode cannot be applied to the present system of blasting. This is an important gain, the vent hole being a decided loss of power, which is well known to gunners, and to counteract which, the Turks are in the habit of covering the touch-hole of their guns with a bag of sand the moment the priming is fired.

It follows that a great economy in the article of gunpowder must result. This is a far more important item in the expense of quarrying and rock excavation, than is generally imagined by those who are unacquainted with such works. In the excavation for the Philadelphia Water Works, for example, nearly 3,000*l.* were expended in gunpowder, and at the rock cutting for the new approach to Edinburgh, by the Calton Hill, 1,000*l.* was spent in this item alone. In granite quarries, the powder for a single shot often costs 3*l.*

In the experiment made under water, 5 lbs. of powder were put into a bladder, and sunk to the depth of ten feet under the surface of the water, in a deserted quarry west of Craigleith. The string was drawn, and the effect was instantaneous; a dull red globe of light, caused by the explosion of the powder under water, was observed, and immediately there followed a considerable shock, which was sensibly felt on the margin of the pool, at the distance of about 100 yards from the explosion; a mass of water, about ten feet in diameter and two feet in height, shaped like a flat dome, rose above the surface of the pool, and immediately after it disappeared, the mud and burned powder boiled up from below like a cauldron.—*Edinburgh Weekly Journal.*

---

### ADAMS'S PATENT RAILWAY CARRIAGE SPRINGS.

The application of a newly invented spring to railway carriages, has satisfied many persons competent to decide on its merits that it will be the means of several highly desirable changes in the construction and fitting up of almost every kind of vehicle used on railways.

The spring alluded to is the invention of Mr. Wm. Adams, the eminent coachmaker, of Drury lane, and author of the very clever, entertaining, and instructive volume, lately published under the title of "English Pleasure Carriages." It was invented by Mr. Adams about a year ago, and has already been very successfully applied by him to private common road carriages. It is called, from its form, the Bow Spring. The back is made of a single bar of well tempered steel, which is attached at the middle, lengthwise, to the axletree. The *string*, or what may be so considered, consists of two equal lengths of single bar steel or prepared hempen cord, the inner ends of which are linked to the body or frame of the carriage. The contrivance may, in fact, be said to consist of three springs—the back, or bow-shaped spring, and the two straight springs which form the chord of the arc, but all three acting simultaneously and in harmony with one another. As the two straight springs play as well forwards as backwards, they serve to prevent any longitudinal concussion, whether the engine be drawing or propelling, or whether the carriages continue moving in one direction, or are brought suddenly to a stand still. The only direction in which they do not play (independently of the carriage,) is from side to side; and therein consists a great excellence, since they thereby help to give lateral firm-

ness to the whole locomotive frame, and to keep it steadily in the line of motion—a line which it is needless to say cannot be *too straight*. The strength of all the three springs may be made proportionate to the weight of the carriage to which they are applied, consideration being paid to the kind of work to be done, and the quality of the road to travel; and as their greatest strength may be always tested beforehand, and no springs need be used that have not been tested to be capable of bearing a much greater strain than any which they are likely to be subjected to when in actual use, they may be said, in point of safety, to leave nothing to desire.

All these matters having been proved in respect to private common road carriages of different kinds, and Mr. Adams having satisfactorily shown that "English *Pleasure* Carriages" give a great deal more *pleasure* with a bow not always bent, but relaxed as circumstances may require, it was determined that an experiment should be made to ascertain whether the *Bow Spring* might not be, with equal advantage, applied to railway carriages. A sett of Mr. Adams's springs was accordingly fitted to one of the Post-office carriages on the London and Birmingham railway, and on the 17th of April last, a carriage provided with the bow springs started in a train from the station at Euston Grove.

The carriage in question had been at the station for several days before the 17th, and was inspected by many persons, several of whom—those, especially, connected with the railway—expressed an opinion that the springs were ill adapted to railway locomotion, and that the experiment about to be tried would fail—in more ways, too, than one.

It was said that the springs were too light.

That they would allow of a great deal too much motion:

That as there were no side guides to keep the axles true, the carriage would run off the rails:

And that they were not strong enough, and would be broken long before the train reached Birmingham.

The result of this difference of speculative opinion was, a great anxiety to see how the actual railway experiment came off (as the sporting phrase is.) Among those who took seats inside the carriage were the inventor of the spring, and several gentlemen well competent to appreciate the merits of the invention. On the outside were an officer of the Railway Company, and one or two post-office guards.

From the moment the train started, the superior ease and comfort of the carriage was felt, and severally acknowledged; but the apprehensions of want of strength in the springs—that the carriage would run off the rails—that they would break, and so forth, still remained, in hardly diminished force, in the minds of several individuals of the party.

At Watford, a pan was filled with water, and placed as nearly as possible in the middle of the carriage, on the floor. As the train attained its full speed, the water in the pan became agitated; at first the motion was irregular, but it soon became circular, and the ultimate effect of the centrifugal action was to throw the water over the pan. By the time the carriage had reached half way between Watford and Tring, nearly half the water had been thrown over the edge of the pan, but no more was thrown over during the remainder of the journey to Tring. At Tring, the train stopt to set down and take up passengers; and here Mr. Adams and his friends were congratulated by the Company's conductor and the two post-office guards on the success of the experiment, so far—the guards observing that it was by far the easiest carriage they had ever rode upon. They also gave it as their opinion, that the springs were of sufficient strength, and well adapted to keep the carriage upon the rails.

From Tring, the gentlemen who had witnessed the preceding experi-

ment, returned to town in a first rate speed carriage, placed at the same relative point in the train as was the carriage in which they travelled to Tring. In the middle of the carriage to which they had thus transferred themselves, and on the floor, they placed the pan before made use of, with the water which remained in it. As the train obtained its full speed, the water became agitated; at first it flew upwards in jerks; but it soon assumed a vibrating motion from side to side, and was forcibly thrown out on each side—ultimately, in quick succession—thus showing the great superiority of the apparently slight and elastic "Bow Springs" over the heavy, clumsy, lapped, and all but rigid, springs in common use.

The equability of the motion of the bow springs was such, that Mr. Adams, while the train was returning at the top of its speed, made a pencil drawing of the invention for a gentleman in the carriage, which it would have been impossible for him to have done in the carriage in which he returned to London.

One of the passengers by the outward train was Lord Macdonald, who had seated himself in his own well hung carriage, placed on a truck with the common springs. At some distance beyond Tring, his lordship accepted an invitation to proceed in the carriage with the bow springs, and travelled in it the remainder of the journey, at the end of which he made some very pointed observations on the superior ease and comfort of the carriage compared even with his own.

The carriage was taken onwards from Birmingham to Liverpool, was returned to Birmingham, and was tried by several of the directors of the London and Birmingham line, who are well qualified to judge of its merits, and by whom it is highly spoken of.

The application of the "bow springs" to every description of railway carriages will be attended with the following very prominent advantages:—

1. A great diminution of friction.

2. Diminution also of weight—because the elasticity of the springs, and the equable motion they produce, will admit of considerable reduction in the weight of almost any part of railway vehicles, and also in the fitting up of the locomotive engines.

3. Security of position on the rails. It has hitherto been deemed necessary to keep the axles in their positions by means of side guides, which, however, prevent them from accommodating themselves to any of the unavoidable inequalities of the railway.

4. Adaptation to all changes of circumstances. It has been found, by exact measurements, that the axles of many railway carriages are not placed accurately parallel, and cannot run true on the same line, the consequences of which are increased friction—increased wear and tear of the rails, the wheels, and the carriages, great additional weight in every part of the carriages to enable them to withstand the violent oscillations and concussions which even a small deviation (at high velocities) from true parallelism in the axles must occasion, while the power given by the bow springs to each wheel to accommodate itself to every ordinary inequality and impediment, is a remedy for all, or nearly all, of the evils to which reference has been made.

Looking at the invention as a whole, it is important to observe that it is one which in no respect depends upon fashion or opinion. It is of so simple and practical a character, that a very brief experience must suffice to settle, beyond all dispute and forever, the question of its utility; and should the result be as favorable to the superiority of the bow spring as we confidently anticipate, then will railway travelling become nearly all that we can every hope to see realized in point of luxurious ease and equality of motion.

## RAILROAD STATISTICS.

The following communication, in relation to the cost of motive power on railroads, is worthy of, and sure to receive, particular attention.

For the American Railroad Journal and Mechanics' Magazine.

GENTLEMEN:—By the politeness of the former superintendant of the Columbia and Philadelphia railway, I have been able to collect some facts relative to the cost of motive power on that railroad, which may not be uninteresting to your readers. The gentleman who furnished them is perhaps the only one in this country that has made the experiment, and is able to show so completely the expenses of the moving power, in every detail; yet on all roads, some kind of accounts are kept which will enable those interested to make a comparison. For this purpose, it is handed to you for publication. It is evident that railroads are not paying as well in this country as in England, and on the Continent; for which, I believe there are two reasons. The one is, that more passengers are taken over the roads in the old world, where the population is more dense; and the other is, our engines are heavier, our roads lighter, aad consequently the *repairs* to engines and roads swallow up the profits. If the machines put on our roads were built with an eye to save repairs to the road, and themselves, the profits would be much greater; but the contrary is the case. No regard is paid to the distribution of weight, if heavy loads are to be drawn, or ascents to be overcome—and the consequence is, the engine and road both soon require repairs; of course, the road pays no profit, and the inquiry is often made, why it is so. The answer usually given is, that the business is dull; which is often an erroneous answer. An engine should be able to run 90 miles per day, and be kept in order for six months; and it will, if properly attended to. The engineman should know as much as the superintendant about an engine. The practice of putting a fireman to run an engine as soon as he knows how to open the throttle, costs railroad companies thousands of dollars. It takes more judgment to run a locomotive than to drive a four-horse stage; yet, how often do we see persons entrusted with one of these valuable, and costly machines, that we would not deem sufficiently careful to take care of a horse. Lessons of experience, gained in this way, do not seem to have their proper weight; *or* the persons at the head of railroad companies, do not receive correct reports. No matter how well an engine may be constructed, it will be soon run down by an inexperienced and careless man, when a person who understands his business would have run the same machine for years. When we find such differences in the cost of motive power, as are exhibited in the annexed statement, we are led to believe that there is mismanagement somewhere; and naturally ask where it is? For my own part, I cannot undertake to say precisely, but can tell where I *believe* it lays; and will do so, in a future number. The statement of the cost of motive power on the different roads, is taken from the memoranda of the Chevalier de Gerstner;

and the other statement in relation to the Columbia and Philadelphia road, was prepared by Mr. Brandt, of Lancaster, Pennsylvania.

In 1838 the cost of motive power, for repairs, oil, fuel, attendance, &c., was per mile run on the

| | |
|---|---|
| Boston and Lowell Railroad, | 94 cents. |
| Boston and Worcester Railroad, | 79 " |
| Baltimore and Ohio Railroad, | 1 60 " |
| Richmond and Fredericksburg Railroad, | 80 " |
| Philadelphia and Columbia Railroad, | 55 " |

The length, and the manner in which each of these roads is built, and the kind of engines used on them, are all before the world, and I presume the readers of the Journal are familiar with their history; it is therefore unnecessary to make any remarks with regard to them. It is also well known that the Philadelphia and Columbia Railway is owned by the State of Pennsylvania, and the motive power is supplied by the State, while the cars are owned by individuals, or companies. In making a statement of what profit the road would have given to the State, if it had owned the cars, we will assume an indebtedness for them in addition to the cost of road and motive power, when we shall find that it paid a profit upon the whole outlay of *nearly* 12½ per cent.

| | |
|---|---|
| Original cost of the road, | $3,333,236 |
| Fifty locomotive engines cost, | 336,000 |
| Various appurtinances, | 330,764 |
| Cost of passenger depots, supposed, | 200,000 |
| Pay of agents and officers, | 55,625 |
| Three hundred and sixty-three cars at $275 each, | 99,825 |
| Twenty passenger cars at $2000, | 40,000 |
| Wear and tear, | 27,964 |
| Contingencies, | 20,000 |
| | 4,443,414 |

In the year 1838 there was carried over the road 87,180 tons

| | |
|---|---|
| 82 miles at $7 1-2 per ton, | 653,850 00 |
| 75,612 passengers $3 1-4, | 245,739 00 |
| | $899,589 00 |

The expenses were for carrying 87,180 tons at $2½, 217,950,
" " " " 75,612 passengers at 1 60, 120,979 80—338,929 80

Net receipts, $550,659 20

Which is 12 39-100 per cent on the preceding statement of cost. I consider it as very remarkable that the State can manage a road with more profit than a company, yet so it is, and as some may doubt the correctness of the assertion, I give the different expenses in detail, which are as follows.

A statement of the cost of working the Philadelphia and Columbia Railroad from October 31, 1837, to October 31, 1838.

| | | | |
|---|---|---|---|
| Cost per trip the distance of 82 miles, | $44 | 03 c. | 5 m. |
| The fuel costs per trip of 82 miles, | 14 | 04 | 1 |
| Cost per ton the distance of 82 miles, | 1 | 55 | 3 |
| Cost per ton per mile 7,562,040 tons, | | 1 | 8 |
| Fuel cost per ton 82 miles, | | 50 | 79-100 |
| Cost of repairs per ton 82 miles, | | 27 | 4 |
| Cost of repairs per ton per mile, | | 3 | 3 |
| Cost per mile travelled for repairs of engines, | | 9 | 7 |
| Cost per mile travelled 260,400, including all repairs, attendance, &c., | | 54 | 99-100 |
| Cost of maintanance of planes per ton 82 miles, | | 18 | 3 |
| Engineer's and firemen's pay per ton 82 miles, | | 18 | 8 |
| Cost of maintenance of planes per mile per ton, | | 2 | 2 |
| Engineer's and firemen's pay per ton per mile, | | 2 | 3 |
| Cost for fuel per mile travelled, | | 13 | 86-100 |
| No. of tons per trip way and through 28 1-5 useful load, | | | |
| No. of cars per trip 14 2-7 | | | |
| Cost of oil per ton per trip 82 miles, | | 7 | 1 |
| Cost of oil per ton per mile, | | | 8 |
| Cost of oil per mile travelled, | | 2 | 5 2-10 |
| No. of tons through and way trains, useful load 42 1-7 | | | |

Total number of tons hauled, allowing 15 passengers to a ton, and 87,180 tons of merchandise, was 92,204 tons 82 miles, as copied from the book of performances kept in that year.

A statement of the work done on the Philadelphia and Columbia Railway by 13 engines, manufactured by M. W. Baldwin, and the cost; said engines being taken in order as they come on the road, being the 13 last furnished by him to the State, from the time they commenced running till 31st October, 1838.

| 1837. When commenced. | Class. | No. of miles travelled. | No. of cars haul'd | No. of ts. dis. 77 ms. 3 ts pr car. | No of ts. dis. 1 m. over ascent of 45 ft pr mile. | No. of trips | No of ts. per trip thro' | Cost of repairs to engines. | Cost pr. m. haul'd | Cost pr ton pr m. | Cost pr ton dis. 77 miles. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Westchester Feb. 19.* | 3d | 30.636 | 1.973 | 5.919 | 455.763 | 268 | 22.08 | 1.715·97 | 5c 6m | .76 | c 28.97 |
| Virginia, Feb. 19.† | " | 36.421 | 3.729 | 11.187 | 861.399 | 473 | 23.65 | 1.658.48 | 4.55 | 1.92 | 14.82 |
| Paoli, Feb. 19.‡ | " | 36.036 | 3.426 | 10.278 | 792.099 | 468 | 21.98 | 1.148.45 | 3.16 | 1.44 | 11.14 |
| Connestoga, Feb. 22.§ | 1st | 5.929 | 1.549 | 4.647 | 357.819 | 77 | 60.35 | 131.62 | 2.21 | .36 | 2.83 |
| Ed. F. Gay, March 24 | " | 25.872 | 7.265 | 21.795 | 1.678.215 | 336 | 64.86 | 1.457.78 | 5.63 | .87 | 6.68 |
| Parksburg, April 2. | " | 24.178 | 6.361 | 19.083 | 1.469.391 | 314 | 60.77 | 1.591.29 | 6.58 | 1.08 | 8.33 |
| Octarara, April 7. | " | 13.552 | 3.628 | 10.884 | 838.068 | 176 | 61.84 | 771.90 | 5.69 | .91 | 7.09 |
| Pequa, April 24. | " | 14,168 | 3.664 | 10.992 | 846.384 | 184 | 59.73 | 1,221.69 | 8.61 | 1.44 | 11.11 |
| Downington, Apr. 16. | " | 26.257 | 7.074 | 21.222 | 1.634.094 | 341 | 62.23 | 1.475.23 | 5.64 | .9 | 6.95 |
| Indiana, May 1. | " | 26.026 | 6.975 | 20.995 | 1.611.225 | 338 | 61.90 | 562.80 | 2.16 | .34 | 2.68 |
| Mississippi, May 9. | " | 15.323 | 3.915 | 11.745 | 904.365 | 199 | 59.02 | 1.384.01 | 9.04 | 1.41 | 11.07 |
| Montgomery, May 15. | " | 21.406 | 5.261 | 15.783 | 1.215.291 | 278 | 54.99 | 830.64 | 3.88 | .68 | 5.32 |
| Wisconsin, May 28.‖ | " | 8.624 | 2.160 | 6.400 | 480.960 | 112 | 51.85 | 82.22 | .95 | .17 | 1.26 |
| | | 274.428 | 56.980 | 170940 | 13.162.380 | 3.564 | | 14.031.59 | 5.18 avera. | 1c. avera. | 9. avera. |

* This engine run 10,000 miles, below the Schuylkill plane, of which the number of cars were not kept.

† Run the passenger train.

‡ Do. do. do.

§ This engine was on the Portage road six months of the time.

‖ This engine was used on a ferry boat, to propel it, at Clark's ferry all the season.

N. B. All those engines whose repairs exceed 1000 dollars, met [during the period of 17 months, at different times,] with accidents, such as running off the track, and breaking their axles, springs, or frames, so that the mere wear alone, or repairs occasioned by running, would have been less. The Westchester is not allowed any cars or expenses for 10,000 miles which she run from Broad-street to the Schuylkill plane—all her repairs being charged to the number of cars she hauled over the road, which, if allowed, would diminish her expenses considerably.

The Paoli and Virginia, run with passenger trains took less cars, but run more trips—the first running 473 out of 530 working days, the second 468 out of the same number of days. One loosing 57 days, the other 62. The other engines did not fill up the time so, because freight was not to be had at all times. Should you publish this communication, you may hear from me again, and I hope from others, giving details in relation to cost of motive power on other roads. A CONSTANT READER.

---

LETTER TO THE SECRETARY OF THE TREASURY, ON THE HISTORY AND CAUSES OF STEAMBOAT EXPLOSIONS, AND THE MEANS OF PREVENTION. BY W. C. REDFIELD.

(Continued from page 30.)

13. *Explosion of a steam-boiler upon the Tyne.*—On Sunday morning, the 2d instant, the Vivid steamboat, belonging to four brothers named Greener, of Shield, was engaged to tow some ships out to sea, and had got her steam up for that purpose, when the owners [who worked the boat] found that she was not in a fit state to do so; they accordingly brought her up, and, while two of the brothers were employed in raking out the fires, the boiler exploded with great violence, and dreadfully scalded two men who were below. They were immediately conveyed home, where they lingered a few hours and then died. The deceased were men of excellent character, and much respected: one was a single man, but the other has left a wife and family to regret his loss. This accident appears to be the more singular, as the boiler had been undergoing some repairs, and was only furnished on Satuaday. An inquest will be held by S. Reed, Esq., coroner, this day, [Tuesday,] at 3 o'clock. Several of the steamboats running between Newcastle and Shields are now in the habit of so much overlading their boilers that, unless some check is put to the practice, we shall not be surprised at some dreadful accident occurring. Some person, who is competent to the duty, should look to this without delay. We are glad to hear that the Government have it in contemplation to appoint an officer for the express purpose of examining steam vessels, and of affording protection to the public.—*Tyne Mercury*, [1838.]

14. *Accident to the boiler of the Sirius**.—London, October 3, 1838. The

* This steamer had recently visited New-York.

Sirius, [steamer,] Ellis, reported yesterday as having sailed from her moorings off East-lane stairs for St. Petersburgh, did not get farther than the Pool, when an accident happened to one of her boilers. The damage can be repaired in two or three days, when she will proceed on her voyage.

15. *Steamer Northern Yacht foundered.*—It has been ascertained that the steamboat Northern Yacht is lost. She was seen to sink, and all on board perished—twenty-three in number.—*English paper,* [*October* 1838.]

16. *Steam-boiler explosion.*—Yesterday morning just before 6 o'clock, the boiler of the steam-engine which moves the machinery in the wadding manufactory of Messrs. Richards and Taylor, of James-street, a short distance south of Kennington Common, blew up with a loud noise, throwing the whole length of the engine house into the street, and with such force as to knock down several yards of a wall on the opposite side of the way, a distance of fifty feet. Had the explosion occurred but five minutes later, when a number of persons would have collected in the street prior to their going in to their work, the consequences might have been fatal to many. The engine is of 30 horse power; but the boiler is only capable of working to 20 horse power. No cause can be assigned for the accident. Fortunately no one was injured.—*English paper,* [*August or September,* 1838.]

17. *Sinking of the Hope steamer.*—A towing steamer, named the Hope, of Shields, on entering the harbor, ran foul of a dredging vessel which is used for cleaning the harbor; the steamer became very leaky, and sunk near the head of the pier. She has since become a total wreck: crew and part of the materials saved.—*Sunderland,* [*Eng.,*] *October* 13, 1838.

18. *Disastrous and fatal accident.*—On the morning of Saturday se'nnight, the neighborhood of Upper Easton, near Bristol, was thrown into great alarm by the sudden explosion of a large steam engine boiler on the premises of Messrs. Bayly & Co., lead smelters. The effect was most terrific, and showed the immense power of steam. The boiler, which was nearly twelve feet high, and thirty-five feet in circumference, and which weighed between three and four tons, was literally carried through the roof of the building, over an adjoining workshop, into a field eighty yards distant, tearing down a stack of chimneys. The shower of rafters, bricks, tiles, and stones, which accompanied the explosion, was truly awful. The roads and fields close to the works were covered with the fallen fragments; and a broad-wheeled wagon, loaded with small coal [the whole weighing four tons] was thrown several yards, and upset; the near-hind wheel being struck off the axle-tree. We are sorry to say that six persons, including the engineer, [who was supposed to have been feeding the fire at the time,] were dreadfully scalded and taken to the infimary. Three of the sufferers have since died. From the inquest, held before J. Langley, Esq. coroner, it was found that the engineer, who has unfortunately perished, was the cause of the accident. He ignorantly overloaded the safety valve, from some misconceived notion of trying the strength of the boiler after it had been newly repaired.—*January* 1836.

19. *Burning of the Royal Tar.*—The British steam vessel Royal Tar, from St. Johns, N. B. bound to Portland, with one hundred passengers, in October, 1836, took fire, owing to some defect about the boiler, and was destroyed. Thirty persons lost their lives by this disaster.

20. *Disastrous shipwreck of the Rothsay Castle steamer.*—The steamer Rothsay Castle, from Liverpool for Beaumaris, was lost in the month of August, 1831, and a great number of persons perished.

A volume of 322 pages, relating to this disaster, is now before me.* To

* Narrative of the Wreck of the Rothsay Castle steam packet. By Joseph Adshead, London. Hamilton, Adams & Co. 1834.

a list of the persons on board, which it contains, the author appends the following statement:—"This list presents the number of 141 individuals who are *known* to have been on board the Rothsay Castle at the period of her wreck; and if the moderate calculation be admitted that nine only were lost, of whom nothing has been heard, it will realize the estimate I have hazarded at page 289, namely: that 150 persons were on board, of which number *one hundred and twenty-seven perished.*"

21. *Dreadful shipwreck of the Forfarshire steamer from Hull to Dundee. Thirty-five lives lost.*—One of the most dreadfully calamitous shipwrecks that has taken place on the coast of England—perhaps involving the greatest loss of life since the loss of the *Rothsay Castle* off the Isle of Anglesea—took place yesterday week, off the coast of Northumberland, when the steam vessel called the *Forfarshire*, on her voyage from Hull to Dundee, struck on the rocks of the Farn Islands, and no less than thirty-five of the passengers and crew perished. This steamer, which was a fine large vessel, of 400 tons burden, provided with two boilers, appears to have been lost owing to the bad state of her boilers; and although she was exposed to very rough weather, yet, as will be seen, her boilers must have been in a defective state when she quitted the Humber.

The Forfarshire sailed from Hull for Dundee on Wednesday afternoon, the 5th instant, at 20 minutes past six o'clock, along with the Pegasus and Innisfail, for Leith. On Thursday morning, about four o'clock, the boiler became leaky, but it was partially repaired; and the steamer proceeded on her voyage, till she arrived at the mouth of the Frith of Forth, about ten o'clock in the evening. It then blew a heavy gale from the northward. The boiler, it would appear, had now become useless, and the machinery stopped. The vessel was got about, in the hope to get her before the wind, but she soon became unmanageable. It rained heavily, accompanied by a violent gale, with a heavy sea, and the vessel drifted towards the Farn islands, on the outer one of which she struck about three o'clock on Friday morning. The captain (John Humble, late master of the Neptune, of Newcastle,) did not, from the state of the weather, know where he was, nor was danger apprehended until breakers were discovered close under the lee of the vessel. As soon as the breakers were discovered, the steward went into the cabin to warn the passengers (who were in bed,) of the danger. They rushed to the deck, which the most of them must have reached before the vessel struck; but as the steamer, almost instantly after striking, parted into two pieces, the whole of the cabin passengers, twenty-five in number, [with one exception, who, with eight of the crew, got on board one of the boats,] are understood to have met with a watery grave. Among the cabin passengers were several ladies. The crew consisted of 22, 10 of whom, and the captain, are drowned. Five steerage passengers and four of the crew were taken off the fore part of the wreck, in the course of the morning, by a boat belonging to the light-house on the island. Thus it would appear that thirty-five persons have lost their lives. Only one cabin passenger, Mr. Ruthven Ritchie, Hill of Ruthven, Perthshire, was saved. —*Leeds Mercury, September* 15, 1838.

22. *Dreadful boiler explosion.*—In Woolhouse's edition of Tredgold, there is mentioned the explosion of a large English boiler of the old spherical form, 20 feet in diameter, in which the thickness of the plates was from a quarter to half an inch; the load upon the safety valve seven pounds per circular inch. Many lives were lost by this explosion; and the boiler was thrown to a distance of 150 feet, to a place 30 feet above the level of its former seat.—*Tredgold*, p. 251.

23. *Blowing up of the Earl Grey steamer.*—On Friday evening, a few

minutes before six o'clock, a dreadful accident took place, occasioned by the bursting of the boiler of the Earl Grey steamer, while she was lying at the steamboat quay, on her way from Dunoon to Glasgow. The Earl Grey had been moored at the quay about 15 minutes, and was just on the point of starting, [the bell having been rung,] when an explosion happened of so dreadful a nature, that the boiler was rent completely round, the roof forced up into a perpendicular position, the upper flues driven into the cabin, and the lower part of the boiler and under flues removed from their situation, blowing the deck completely off from the funnel, to within eight or nine feet of the stern. The unfortunate persons who were standing on that part of the deck were blown into the air; two of these fell upon the quay, both of whom died immediately after; the rest fell into the sea. The water from the boiler was thrown nearly to the west end of the steamboat quay, over the shed, on board two vessels, the Jean and the Rebecca; the rope which fastened the steamer's stern to the quay was blown on the top of the shed, also camp-stools, large pieces of wood, &c. A part of the boiler, six or eight feet square, was driven, by the force of the steam, a distance of 100 feet and upwards. A great number of persons standing on the quay were much injured by the scalding water, and by pieces of coal, wood, &c., falling on them.

By this melancholy event, six persons have lost their lives, fourteen been severely injured, and twelve slightly, [thirty-two in all;] but it is impossible at present, to state the precise number of the sufferers by this dreadful occurrence, as it is believed that some of those thrown into the water have not been found. The steward says that before the accident, he counted 27 persons on the quarter deck, and considers that there were about 40 persons on board at the time of the explosion.

The steward of the Earl Grey, while standing on the paddle-box was knocked overboard by a large piece of coal, but got out little injured. Excepting the steward and one seaman, who was killed, no other person connected with the vessel was hurt. A young lady, Miss Stevenson, had gone on board the vessel, accompanied by her sister and a young gentleman, a few minutes before the accident took place. The young man had gone forward to the bow, leaving the two young ladies standing abaft the funnel at the moment the explosion occurred. When the steam and smoke had cleared away, he discerned one of the Misses Stevensons, in the water at a considerable distance from the vessel, and, although an indifferent swimmer, he plunged overboard and saved her. The body of the other sister was got out of the water an hour and a half after the accident, by the boats which were employed in trauling, but no other body has yet been found.

Mr. Mathew King, of Port Glasgow, who was with Mrs. King, blown overboard, saved himself by clinging to a block attached to a rope which hung over the vessel's side. While in this situation, he saw Mrs. King floating; he immediately got hold of her, and, while supporting himself with one hand, and holding his wife with the other, some person seized hold of the rope Mr. King was clinging to, and nearly pulled it from his hand. Mr. King with great difficulty, got him to desist until a boat came to their assistance, and rescued them just in time, as Mr. King had become completely exhausted. Mr. Hugh Watson, who is mentioned among those killed, was on the deck at the time of the explosion, the force of which blew him and Angus Wilkie, who was loosing the stern line at the moment, a great height into the air. They both fell on the quay, and the bruises they received from this, together with the effects of the steam and the scalding water, caused almost instant death in both cases.

Mr. Peter Somerville, of Glasgow, one of the passengers, who saved

himself by his singular activity and presence of mind, described to us, in the following manner, the circumstances connected with the blowing up of the vessel, as far as his own observations had extended. Mr. Somerville was surprised at perceiving the cabin to be full of steam, and, becoming apprehensive that something was wrong, he advanced to the farthest end, when a hissing noise which he heard convinced him that an explosion was about to take place, and he sprung suddenly out at one of the cabin windows, breaking the glass, a pane about 14 inches square. Instantaneously as this was done, the explosion occurred before his legs were quite out of the window, and his feet were scalded by the hot water, or steam rushing into the cabin. Fortunately Mr. Somerville succeeded in catching hold of an iron rod projecting from the stern, by which he hung until the stern boat had been lowered, when he was drawn up to the deck of the vessel. While thus hanging by the steamer's stern, Mr. Somerville looked down into the water, in which he thinks he observed about thirty persons, many of whom appeared to have been hurt by the explosion, and were streaming with blood. He saw six or seven couples clinging to each other as if resolved to be saved or lost together. On being hauled up the stern, Mr. Somerville found that the greater part of the deck had been torn up. On the only portion of which now remained, namely, a few feet of the stern, he observed an old gentleman evidently much hurt, and a lady of apparently about forty years of age, who was either dead or had swooned. All the other cabin passengers appeared to have been blown off the deck by the violence of the explosion.

The quay at which the vessel was lying at the time of the accident was in an incredibly short time crowded by persons of all descriptions.

The excitement was much increased by the wounded sufferers being borne along the streets to the infirmary, and various other places. The steamboat quay, about seven o'clock, presented a scene of horror happily never before witnessed here--mangled and bleeding bodies carried to the places where aid could be administered; the boats employed in trauling for the bodies rowing backwards and forwards, anxiously watched by the spectators whenever the men aboard hauled up the creepers, to which, in almost every case, were hanging pieces of clothes, shirts, handkerchiefs, &c. But the most fearful spectacle of all was the vessel herself--the roof of the ponderous boiler poised in mid-air, over which the funnel lay crushed and broken; the uptorn decks exposing the cabin, into which the upper flues of the boiler had forced their way; while hats and portions of male and female attire were strewed around, telling too truly of the fearful destruction that had taken place. It may be consoling to the friends of those who were injured to know that every thing which humanity and skill could devise was done to alleviate the agonies of the unhappy sufferers.—*Greenock Intelligencer, July*, 1835.

24. *Explosion on board the Victoria steamer.*—On the 14th of June 1838, a dreadful accident happened in the river, by the explosion of a boiler on board the Victoria, Hull steam-ship, by which nine unfortunate men lost their lives.—*Shipping Gazette.*

This explosion, and another which also occurred on the Thames a few months previous, on board the same vessel, by which several lives were lost have already been alluded to.

There are other cases of like character before me of earlier date which I omit to notice; but the above are sufficient to show that these accidents are not confined to American steamboats, but often occur with low pressure engines under the English practice.

The various hazards and casualties here enumerated serve not only to

show that the hazards which have hitherto attended the use of steam are not confined to our own country, but that the use of steam of only five or seven pounds pressure to the inch, with a dependence on nicely adjusted safety-valves and other apparatus, will not insure safety; and that the latter must be sought in the surplus strength of the boilers employed.

Of the foregoing cases of the shipwreck of English steamers, it may be remarked, that a large portion of those which were most disastrous, could probably have been avoided had their engines possessed equal efficiency with those which are used in the New York steamboats.

*Steamboat Legislation.*—The subject of legislative enactments for promoting the security of passengers in steamboats, has often been a matter of discussion since the latter were first introduced in our country. But, till recently, there has appeared an evident reluctance to legislate on subjects relating to the arts and occupations of particular professions; such interference being generally considered as ungenial to the character of our institutions, and contrary to sound policy. The objections to legislative interference were peculiarly strong in the case before us, owing to the infancy and importance of the art in question; the professional knowledge and experience which were required to regulate it with success; and the difficulty, not to say impracticability, of devising a system of legislation which should be adapted to all the diversified circumstances of this great country, and to the rapidly improving state of the art itself.

There is, however, but a small fraction of the people of the United States who are directly concerned in steam navigation, and the unhappy disasters which have attended it have presented to our contemplation dangers of a new and appalling character, and have occasioned ceaseless efforts for the accomplishment of such legislation as should, in reality or appearance, offer security to those persons, who, under the lively impression of danger, could discover little else than incompetency, treachery, or suicidal depravity, in those who conducted the operations of this new and powerful element of locomotion. A few in the profession itself, being impatient, perhaps, of the opposition offered to their views, or of the continued existence of evils and defects which to them appeared susceptible of a prescribed remedy, have joined in recommending the interference of the national legislature. It remains to be seen whether this interference is to be productive of more good than evil. That it has signally failed in preventing the recurrence of the calamities which have been deprecated, is too apparent in the explosion of two steamboats on the Mississippi, which were fresh from under the legal inspection, and which have been attended with a fearful destruction of life.* It is much to be apprehended, therefore, that these enactments can serve no better purpose than to relieve the owners and managers of steamboats, in a measure, from that weighty sense of responsibility to the public under which they have hitherto labored, irrespective of their private interest in the safe and prosperous conducting of their business.

But, aside from the more than questionable policy of some of the enactments of the statutes in question, there is one provision, adopted without notice, and, apparently without premeditation, which appears to be a reversal of the principles which have hitherto prevailed in our system of legislation and jurisprudence—a provision which appears as injurious and unjust in its implications of a most useful, worthy, and patriotic class of fellow-citizens, as is the misapprehension of fact and of character, on which it would

* Other deplorable accidents have since been added to the catalogue; and these renewed disasters may serve to show, first, that the remedy does not lie within the reach of the legislature; and second, that our western friends *must* relinquish their ultra system of high pressure, which has so long been cherished on their waters.

appear to have been founded. I shall be understood as alluding here to that provision of the late law of Congress which assumes the owners of steamboats to be guilty of misconduct and liable for all injuries or losses, in cases of injury or explosion by steam, unless they may be able to produce satisfactory evidence to the contrary—a task which, with the purest conduct and intentions on their part, might often be rendered impossible. It is sincerely desired that such a provision may not long be found in our statutes. The common law of the country is sufficiently relentless and severe in all cases of implied criminality, or even of negligence; and a resort to the enactment in question would seem justifiable only in relation to a class of persons who were universally and odiously criminal, instead of a class who, in every thing which constitutes private worth and good citizenship, are probably not inferior to most others in our country.

The owners and constructors of steam vessels have not been examined or consulted by the committees which have been charged with the preparation of the late law. Nor have those persons intruded their private opinions and views upon Congress, nor upon the public. Still less have they been disposed to place themselves in an attitude of defendants, on groundless and absurd allegations; or even to plead the great benefits which they have rendered, or the sacrifices which they have made, while engaged in advancing one of the most important interests of the public and of the civilized world. While the state of the country, its society, its business and enjoyments, have been so rapidly improved or changed by their operations as to excite the wonder not only of an admiring world, but even of ourselves, these persons have been content to labor, through good and evil report, as willing instruments in the rapid advancement of their country in its industry, knowledge and power. Well might they have anticipated any other notice from the supreme power of their country, rather than the apparently ungracious rebuke which seems to be implied in the above enactment.

The pecuniary sacrifices which have been made by the owners of steamboats, while thus advancing their country's best interests, have been great almost beyond example. It was estimated, some five years since, that the amounts which had then been lost by the owners of steamboats which have navigated the Hudson, this queen of rivers, was sufficient to have constructed a good railroad between the cities of New-York and Albany; and there is reason to believe that the losses have been at least proportionate in other sections of our country. Surely, it might have been expected that this interest, above all others, would have been deemed worthy of the countenance and protection of our National Legislature.

In a reply to the inquiries of the honorable Louis McLane, Secretary of the Treasury, dated December 23, 1831, (which appears as No. 3, in document No. 478 of the House of Representatives, 1st session of the 22d Congress,) I have cursorily noticed some of the points which are herein referred to. To this communication, and especially its concluding remarks, I beg leave now to refer.

Of the regulations for preventing collisions in navigation, those which are found in the laws of the State of New-York are, in my view, of far greater practical value than those which are found in the late act of Congress.

Among those persons who control the forms and modes of construction of steam-boilers and engines, there is found much variety of opinion and practice, which necessarily occasions different degrees of excellence or defectiveness. To unite, at once, these various views in the most perfectly approximate system of security and efficiency, by the operation of a blind

external power, is quite impracticable. It is only by extensive practice and patient observation that so desirable a result can be reasonably expected; and *time* is essential to its attainment. It is not unreasonable to expect that the period is rapidly approaching in which American steamboats will as far exceed those of other countries in safety from explosions, as they now do in practical efficiency, and in skilful adaptation to the purposes for which they are specifically designed.

*Prevention of explosions.*—In adopting rules of construction for boilers, it should be considered that iron is liable to be permanently affected by a force which is equal to only one-third of that which is necessary to produce immediate fracture. The point of maximum pressure, therefore, at which the steam-gauges should be adjusted, so as to blow off their mercury, should never exceed one-third of this subordinate force. In other words, the highest pressure of steam allowed under any circumstances, should not exceed *one-ninth* of the force, which may be fairly estimated as necessary to break or immediately injure the boiler, instead of being equal to only one-third or one-half of this force, as is recommended in Woodhouse's edition of Tredgold,* and, as I am informed, is usually practised in England.

Experiments, if deemed necessary, might be made upon boilers of the different forms of construction which are commonly brought into use; and these experiments, together with the estimated tenacity and stiffness of the metal employed, would serve for a basis in estimating the strength of any boilers, and the actual proof be thus avoided; for, a proof of high tension may, by its incipient effects, tend to produce, ultimately, the very disasters which it was intended to prevent.

Much has been said and written on the means of preventing explosions; and if the efficacy of the various preventives which have been proposed, had only been equal to the zeal and confidence with which they have been sometimes urged, we should have little occasion for pursuing the inquiry.

Of the experimental investigations which have been made, unconnected with working practice, none have a higher claim to consideration than those made at Philadelphia by a committee of the Franklin Institute; and the elaborate report of this committee must be considered as a document of high value and great practical utility. The report of the committee of the American Institute of this city, on the explosion of steam-boilers, is also a well reasoned production, indicating a thorough knowledge of the subject on the part of the committee; although I cannot accord to the implied conclusion, that the use of steam of more than seven pounds pressure to the inch must, necessarily, be considered as dangerous.†

Notwithstanding all which has been said and done on the subject of nicely-adjusted safety-valves and other apparatus, explosions still continue to occur; and so long as boilers continue to be subject to insidious and unknown defects, and the limit of their strength is found to be too nearly that of the working pressure, they cannot be expected to cease. The safety-valve and the mercurial gauge, as now used, are perfect instruments of their kind, and have all the adaptation that can reasonably be desired for showing the actual pressure, and for regulating its excess. In regard to the supply of water and its indications, good pumps of proper construction, with the ordinary gauge-cocks, glass tubes, and good attendance, constitute the safeguards most to be relied on. A thermometrical instrument might be added to the boiler, without detriment. Water-floats and their fixtures, I consider as ob-

* Tredgold, Part I., pp. 259, 240. London, 1838.
† See Journal of the American Institute, September, 1838. p. 646.

jectionable in marine boilers, and will not be found practically useful. In the present state of the art, new inventions of apparatus do not appear to be required, but only the judicious and proper use of such as we now possess, combined with boilers of *sufficient strength* to resist successfully all the ordinary defects, deteriorations and exposure, which may arise during their use, from inattention or otherwise.

If high-pressure engines must continue to be used, [of which I see not the utility or necessity,] the working pressure *should never exceed fifty pounds to the square inch;* and this may be easily effected by increasing the size and stroke of the working cylinders and piston.* The forms of the boilers should be cylindrical, and their diameters from 36 to 42 inches, supported by their centres as well as at their terminations. Flues, if of a size affording but one or two in each boiler, are always dangerous; they displace too much water, and also obstruct the proper cleaning. Flues, however, are not to be dispensed with; but their number should be increased and their size diminished. An upper tier of four flues, and a lower tier of two [the latter somewhat larger than the former,] are not too many for boilers of 42 inches diameter; or 44 to 48 inches, if low pressure. These smaller flues, if properly arranged, will greatly facilitate the cleaning, and displace but little water; but their length should not usually exceed ten or twelve feet, as they abstract the heat very rapidly, owing to their small size. They will be better if made perfectly smooth on their inner surface, from a single long sheet of iron, lighter than the shell; and are not often liable to leaks or accidents. The outer shell should never be less in thickness than a full quarter of an inch; and a thickness much exceeding this, it is well known, cannot be used with advantage.

In condensing engines which work expansively, called low pressure, when working with ordinary speed, the pressure of steam should usually range between one and one and a half atmospheres above the boiling point. But on emergencies, the pressure may be increased to two atmospheres. *The boilers should have a range of strength falling but little short of those used for high pressure.* They may be constructed of the common wagon-top form, provided that they are properly braced in their flat sides and arches, and have as many as four or six flue-arches for a boiler of eight or ten feet in width. The returning flues should be cylindrical, and of smaller diameter. The water sides, water bottoms, bridge walls, and all other flat surfaces, should, however, be brace bolted at intervals of six inches; and the arches, shell, and all other portions, secured in a proportionate manner. If a *steam chimney* is used, even of the circular form, it should be brace-bolted at smaller intervals than any part of the flat surfaces which are covered by water.

Flat water-sides, ends, and bridge-walls, if rightly constructed, may be adopted with great safety and advantage for high-pressure boilers; but the brace-bolts, in these cases, should be at intervals of one to *five inches.* Good brace-bolts of iron, eleven-sixteenths of an inch in diameter, with light sockets, if the same are well and securely driven, will be sufficient.† These

* Since the above was written, I have seen the Report of Dr. Locke, on the disastrous explosion of the new high-pressure steamboat Moselle, at Cincinnati, in April, 1838; and I am happy to find that my general conclusions appear to be confirmed by the facts and observations which have been adduced by this distinguished friend of science: although there are some few of his positions that perhaps cannot receive the sanction of practical engineers. After an able examination of the facts in this case, Dr. Locke comes to the conclusion, that "with probably a sufficient supply of water to protect her flues, and the safety-valve over loaded, the Moselle burst her boilers by a pressure greater than the strength of her boiler iron, undiminished by heat, could sustain."—Report, &c. p. 52, Cincinnati, 1838.

† These brace-bolts are better to be screwed in, without sockets; and afterwards riveted, with or without an outside nut or screw-head.

water-sides and ends may be so worked on to the cylindrical portions of the boilers as to form one structure, in which a greater circulation may be provided for, and much of the ordinary sediment be prevented from becoming injurious to the boilers. The same principal of construction may also be adopted for low-pressure, as has been done in the boiler which has been used in the steamboat Oliver Ellsworth since 1833; but in such case the cylindrical portions or shells may have a diameter of 44 to 48 inches. The boiler heads should in all cases be of wrought or rolled iron, of extra thickness and securely braced. An addition, in the form of a truncated cone, may be affixed on the top of each cylindrical portion, in order to increase the steam room and to communicate with the steam pipe. The top or head of this appendage may be of cast iron, and calculated to receive the manhole plate and safety valve.

For low pressure boilers, the general form of the locomotive boilers, with numerous small flues, has been successfully adopted. For these boilers, if the requisite provisions for strength be carefully attended to, copper may sometimes be admissible; but in this case, the securities should greatly exceed those of an iron boiler of the same general construction.

In specifying these methods of construction, no new or untried plans have been suggested; but only those of known advantage and efficiency, such as have fallen within my own observation or practice.

In the use of muddy or salt water, the blow-off cock should be frequently and freely used. Condensation in a multiplicity of pipes, and the use of the distilled water thus obtained, on the plan which Mr. Hall has introduced in England, will probably be found attended with more advantages than inconvenience, particularly in sea voyages.

Boilers should at all times be kept free from sediment, and the riveted joints, especially those which are exposed to the fire, should be made subject to frequent and careful examinations, and the smallest appearance of leakage in these should receive immediate attention.

But, with all these precautions, it is *possible* that accidents of a serious character may sometimes happen to steamboats, as well as to ships, bridges, carriages, and other structures, in which much care and attention have been given to the best means of security.

Should the facts, however, which have fallen within my knowledge or observation, as set forth in this communication, or the conclusions derived therefrom, contribute, in any degree, to the correction of prevailing errors of theory or opinion, and cause a greater reliance to be placed upon the most available of all remedies, namely, *a proper increase in the strength of boilers, together with the abandonment of the higher degrees of pressure*, and thus secure a greater degree of safety to the travelling public, my object in thus responding to the call of Congress will be happily attained.

I am, sir, very respectfully, your obedient servant,

WILLIAM C. REDFIELD.

Hon. LEVI WOODBURY,
*Secretary of the Treasury.*

---

ARBROATH AND FORFAR RAILWAY.—One of the afternoon trains yesterday brought from Forfar, with a single engine, no less than *forty-three* wagons, loaded with timber and pavement, and two carriages, containing forty passengers. The gross weight of the goods' train amounted to two hundred and thirty-two tons. This is an achievement to which no parallel can be found in the annals of railways.—*Arbroath Herald, July 5.*

SEMI-ANNUAL REPORT OF THE DIRECTORS OF THE LA GRANGE AND MEMPHIS RAILROAD COMPANY, JULY, 1839.

Although it is not required by the charter to report until the close of the year, the peculiar situation of our affairs, seem to demand a brief semi-annual exhibit, as well for the satisfaction of the public generally, as the stockholders. Besides, the ensuing session of the General Assembly, will in all probability be the only one until the Road is finished; and if any legislative aid is sought, no time should be lost in apprising the stockholders of the state of our finances; and in suggesting such measures of relief, as may be judged practicable and expedient. An interchange of ideas, and mutual concessions, will alone enable us to approach the Legislature, with any probability of assistance. For apart from the diversity of opinion, attending the discussion of subjects of this nature, we are divided and distracted upon national policy, almost exclusively based upon that branch which relates to the state of the currency, and the measures which should be adopted to produce an uniform value in commercial or bank paper.—We think that the policy of creating State Banks is not now a subject open for discussion. A prudent exercise of the power, in constituting corporations, with banking privileges, is the only thing we shall examine—believing it the part of common sense to take the laws of commerce as we find them, and to accommodate ourselves to circumstances, over which we have no control.

It will be seen by statements herein made that the whole of the capital stock, to wit: $375,000, has been called. The individual stockholders are generally solvent and in ordinary times would be able to meet the demands. But with every reasonable exertion it has been found impossible to make collections. The truth is, the money is not in the country—and nothing but a bountiful crop and the increase of a sound bank paper currency can enable the Directors to enforce payments without producing a pressure which the stockholders, and thiscommunity generally, are ill able to bear. We have been reluctantly compelled to institute suits against all stockholders who have not paid fifty per cent., and unless a temporary loan of 50 or 60,000 dollars can be obtained shortly, we shall be obliged to extend the order to the remaining half. To avoid this oppression every effort has been made, and we now earnestly entreat every friend of the enteprise to lend a helping hand. Let each and all make a sacrifice of some cherished opinions to attain an acknowledged benefit. We can at all events agree to memoralize the Legislature for our rights—not the least important of which, is the assignment of our just proportion of banking capital. This West Tennessee is entitled to, and this we must have, or abandon our favorite schemes of Internal Improvement.

The unintelligible Banking and Internal Improvement and Common School law of last session, is pretty generally admitted to be next to a dead letter, and unavailable to any Railroad or Turnpike Company managed in good faith; and for all practical purposes, is nothing less than a downright mockery. For if it was intended that each and every stockholder, however small their subscription, should advance 15 per cent. before the State could be called upon for her quota, a default in the payment of $15, or an instalment on one poor share, might defeat the whole object of the law. Companies formed by general subscription, in ninety-nine cases out of a hundred, would contain some stockholders, who, from inability or neglect, would fail to meet their calls, and thereby render the State's subscription inoperative. What the next Legislature will do with or about this indefinable statute is of but little consequence to our Company, unless it could be amended so as to be acceptable., and that is not probable.

Then what ought the citizens of West Tennessee to petition for? We say an INDEPENDENT BANK, based upon legitimate banking principles; with a capital which shall be equal to one-third of the whole banking capital of the State—the Principal Bank to be located at Memphis, with Branches established at as many points as the capital and business of the country will justify—or a Bank connected with our Railroad Company, on the plan of the Charleston and Cincinnatti Railroad and Banking Company. The latter we would prefer for several reasons. Indeed it is difficult to conceive the plan of a Bank less exceptionable, or better calculated, with judicious management, to secure public confidence. It would have an independent action of the Railroad Company, and in every respect be conducted as banking institutions generally are, except that the Railroad Company would guarantee the redemption of the issues of the Bank. The only advantage that the Railroad Company would derive, over and above the usual bank facilities, would be this: Every stockholder in the Road would be entitled to become a stockholder to the same extent in the Bank—That is, if he owned say 10 shares in the Road, he would have the refusal of 10 or 5 shares in the Bank—and to obtain shares in the Bank as many must be subscribed to the Road. And although the Railroad Company will be liable for the debts of the Bank, the Bank will not be responsible for the debts or mismanagement of the Railroad Company. We are aware that Railroad Banks, or Banks connected with works of Internal Improvement, have frequently been unsuccessful, but it should be borne in mind that in every instance of failure, the charters were defective. They were permitted to base their issues upon the credit of the stockholders, instead of a metalic capital and actual road formation combined, as we propose.

If we obtain the privilege we desire it will enable us to extend the Railroad from La Grange to the Mississippi line in the direction of Tuscumbia, in fulfilment of our original design of uniting with the Alabama, Georgia and South Carolina Rairoads.

Early in January last we memoralized the Legislature of Mississippi, to grant a charter for so much of the contempleted Railroad from Memphis to Charleston as might lie in that State, which was most unexpectedly refused. But we are informed and believe, that there will be no difficulty, at the next session, in arranging matters to our satisfaction. Should that State, however, persist in her unreasonable opposition to this great work, it should prompt the Legislature of Tennessee to proceed forthwith with the line, from La Grange to Chattanoga, the terminus of the Georgia Road. And we are of the opinion that whatever may be the course of Mississippi in relation to it, the practicability of a direct eastern route along our southern border should be tested without delay. For, the consummation of this magnificent design devolves upon Tennessee. South Carolina and Georgin have done their duty, and Tennessee must perform her part if she would avoid disgrace.

The La Grange and Memphis Railcoad and the branch from Moscow to Somerville, will be completed next year, or nearly so—certainly if the Legislature grants the expected facilities.

It will be seen by reference to the reports that the entire line will soon be ready for the superstructure, and that is being laid from Memphis to Germantown.

The state of the Treasury at present will appear by the following abstract of the Cashier's exhibit, embracing some of the most important items of information in relation to the receipts and disbursements of the Company, from its organization, June 15th, 1836, up to the present time:

*Abstract of the Cashiers Exhibit.—Receipts.*

| | | |
|---|---|---|
| Received from individual stockholders, in cash, bonds, discounts, &c., | | $88,183 12 |
| Seventy-five per cent. of State Stock in Bonds, | | 93,750 00 |
| | | $181,933 12 |

EXPENDITURES.

| | | |
|---|---|---|
| For Real Estate, (13 acres near La Grange,) | | $1,355 06 |
| Personal Property, Engineering Instruments, Tools, &c., | | 1,698 11 |
| Engineering Account, | | 26,540 71 |
| *Road Formation.* | | |
| Grubbing account, | $22,659 71 | |
| Grading account, | 91,173 71 | |
| Culverts and Drains, | 4,060 50 | |
| Bridge account, | 600 00 | |
| Timber account, | 12,636 60 | |
| Superstructure, | 171 79 | |
| | | 131,302 31 |
| Per centage retained on unfinished contracts not yet due, | | 15,833 00 |

(To be continued.)

THE DRY ROT.—It is stated as an important fact, and one worthy of general attention, that timber cut in summer resists the dry rot far better than winter felled timber; that the doctrine of sap being principally in the roots of trees in the winter is false, and should be discarded for the mischief it has already done; and that the truth should be established, which is, that in the winter, the sap is in the tubes of the heartwood of the whole tree, roots, and body, and branches, and is there protected from injury by the frost. In the summer the sap is in the tubes of the albernum, or outer covering of the heartwood, and when timber is felled at this season, should the dry rot attack it, the albernum only disappears, and the heartwood remains sound and dry. On the contrary if the timber is cut when the sap is in the tubes of the heartwood, [*i. e.* in the winter,] the disease continues its ravages till the whole is rendered useless.

THE IRON TRADE.—We learn from a very elaborate paper read by Mr. J. Johnson before the Liverpool Polytechnic society, that there are at this time in Scotland fifty furnaces in blast, five out, seven building, and tmenty-six contemplated. In South Wales, 122 furnaces in blast, seven out, thiy-one building, ninety-one contemplated. In 1740 the annual produce of the kingdom was 17,350 tons of cast iron. Mr. Johnson thinks it probable, from the above data, that in 1842, Scotland alone will produce upwards of 360,000 tons, and that within five years 1,000,000 tons, will be produced annually in South Wales. The market for metals has been greatly influenced by the money market; and though further pecided fall in the quotation to be noticed, the business is becoming exceedingly limited, and a general decline in prices is expected to take place, should there not be a better demand for the export trade.—*Midland Counties Herald.*

ERRATA.—Page 34, communication on "The true expression of the Power, etc. of Locomotive Engines," seventh line from top, for 'effected' read *affected*. Page 36, sixth line, for 'calculations,' read *calculation*. Same page, sixteenth line, for 'evaporation,' read *evaporated*. Same page, twentieth line, for 'or,' read *for*. Page 38, last column in the table, instead of '·01' it should have been ·01— Page 39, note b., second line, instead of 'fore 4' read *fore* ·4.